

## CLAIMS

What is claimed is:

1 1. A packaging structure comprising at least one semiconductor device bonded to a  
2 chip carrier or heat spreader with an adhesive, wherein the adhesive is reworkable and  
3 thermally conductive and comprises a cured reaction product from a diepoxide and cyclic  
4 anhydride wherein the epoxy groups are connected through an acyclic acetal moiety; and  
5 a thermally conductive filler.

1 2. The packaging structure of claim 1 wherein the diepoxide is a cycloaliphatic  
2 diepoxide.

1 3. The packaging structure of claim 1 wherein the diepoxide is selected from the  
2 group consisting of acetaldehyde bis (3,4-epoxycyclohexylmethyl) acetal, acetone bis-  
3 (3,4-epoxycyclohexylmethyl) ketal, and formaldehyde bis- )4,4-epoxycyclohexylmethyl)  
4 acetal.

1 4. The packaging structure of claim 1 where the diepoxide is acetaldehyde bis- (3,4-  
2 epoxycyclohexylmethyl) acetal.

1 5. The packaging structure of claim 1 wherein the filler is non-electrically  
2 conductive.

1 6. The packaging structure of claim 1 wherein the filler is selected from the group  
2 consisting of silver flake, aluminum nitride and silica-coated aluminum nitride.

1 7. The packaging structure of claim 1 wherein the filler is aluminum nitride or silica-  
2 coated aluminum nitride.

- 1 8. The packaging structure of claim 1 where the adhesive further comprises a  
2 thixotropic agent.
- 1 9. The packaging structure of claim 1 wherein the filler is electrically conductive.
- 1 10. The packaging structure of claim 1 where the thixotropic agent comprises silica or  
2 siloxane-coated fumed silica.
- 1 11. The packaging structure of claim 10 wherein (a) the amount of diepoxide is about  
2 10 to about 30% by weight, (b) the amount of cyclic anhydride is about 10 to about 30%  
3 by weight, (c) the amount of filler is about 40% to about 79% by weight and (d)  
4 thixotropic agent about 0.05 to about 2% by weight, the amounts being based on the  
5 total of (a), (b), (c) and (d) in the composition.
- 1 12. The packaging structure of claim 1 wherein the adhesive provides a void-free  
2 bond.
- 1 13. The packaging structure of claim 1 wherein the at least one semiconductor device  
2 is bonded to a chip carrier and is electrically connected to the chip carrier with  
3 wirebonds.
- 1 14. The packaging structure of claim 1 wherein the at least one semiconductor device  
2 is a flip chip and the flip chip is bonded to the heat spreader.
- 1 15. The packaging structure of claim 14 which further comprises an underfill  
2 encapsulant.

16. A method for fabricating a packaging structure which comprises bonding at least one semiconductor device to a chip carrier by applying a composition comprises a diepoxide wherein the epoxy groups are connected through an acyclic acetal moiety, a cyclic anhydride and a thermally conductive filler; and curing the composition to provide a reworkable and thermally conductive adhesive.

17. The method of claim 16 wherein the diepoxide is a cycloaliphatic diepoxide.

18. The method of claim 16 wherein the diepoxide is selected from the group consisting of acetaldehyde bis- (3,4-epoxycyclohexylmethyl) acetal, acetone bis- (3,4-epoxycyclohexylmethyl) ketal, and formaldehyde bis- (3,4-epoxycyclohexylmethyl) acetal.

19. The method of claim 16 where the diepoxide is acetaldehyde bis- (3,4-epoxycyclohexylmethyl) acetal.

20. The method of claim 16 wherein the filler is non-electrically conductive.

21. The method of claim 16 wherein the filler is selected from the group consisting of silver flake, aluminum nitride and silica-coated aluminum nitride.

22. The method of claim 16 wherein the filler is aluminum nitride or silica-coated aluminum nitride.

1 23. The method of claim 16 wherein the adhesive further comprises a thixotropic  
2 agent.

1 24. The method of claim 16 wherein the thixotropic agent comprises silica or  
2 siloxane-coated formed silica.

1 25. The method of claim 24 wherein a) the amount of diepoxide is about 10 to about  
2 30% by weight, b) the amount of cyclic anhydride is about 10 to about 30% by weight,  
3 c) the amount of filler is about 40 to about 79% by weight and c) thixotropic agent is  
4 about .05 to about 2% by weight, the amount being based upon the total of a), b), c) and d)  
5 in the composition.

1 26. The method of claim 16 wherein the at least one semiconductor device is  
2 electrically connected to the chip carrier with wirebonds after curing of the composition.

1 27. The method of claim 16 wherein the at least one semiconductor device is a flip  
2 chip and wherein the flip chip is bonded to a heat spreader.

28. A reworkable thermally conductive adhesive composition comprising a) about 20 to about 60% by weight of a cured reaction product from diepoxide and a cyclic anhydride wherein the epoxy groups are connected through an acyclic acetal moiety b) about 40 to about 79% by weight of a thermally conductive filler; c) about 0.05 to about 2% by weight of a thixotropic agent based upon the total a), b), and c) in the composition.

1    29.    The composition of claim 28 wherein the diepoxide is a cycloaliphatic diepoxide.

1 30. The composition of claim 28 wherein the diepoxide is selected from the group  
 2 consisting of acetaldehyde bis- (3,4 -epoxycyclohexyl) acetal, acetone bis- (3,4-  
 3 epoxycyclohexylmethyl) ketal, and formaldehyde bis- (3,4- epoxycyclohexylmethyl)  
 4 acetal.

1 31. The composition of claims 28 wherein the diepoxide is acetaldehyde bis- (3,4 -  
 2 epoxycyclohexylmethyl) acetal.

1 32. The composition of claim 28 wherein the filler is non-electrically conductive.

1 33. The composition of claim 28 wherein the filler is selected from the group  
 2 consisting of silver flake, aluminum nitride and silica-coated aluminum nitride.

1 34. The composition of claim 28 wherein the filler is aluminum nitride or silica-  
 2 coated aluminum nitride.

1 35. The composition of claim 28 wherein the thixotropic agent comprises silica or  
 2 siloxane-coated firmed silica.